Automatic
For over 40 years, Griswold Controls has designed and manufactured automatic flow control valves for HVAC and Industrial applications. You can use them in open and closed systems, for flows from 0.33 to 17,000 GPM in pipe diameters of 1/2 to 30 inches.

Accessible
You can remove the flow cartridge without breaking the pipe connection. You can automatically control flow on the supply or return side of the coil.

Adjustable
Only Griswold Controls gives you automatic flow control cartridges with multiple flow settings that can be field selected. You don’t have to replace the cartridge to change the flow.

All-In-One
Griswold’s Automizer gives you everything you need for the return side of the coil. By combining flow limiting and temperature control into one multi-function valve, Griswold saves you time and money!
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Griswold on the Web: www.griswoldcontrols.com
General Web Site Information: info@griswoldcontrols.com
Automatic Versus Manual Balancing

of HVAC Hydronic Systems

HVAC hydronic systems primarily use chilled water and hot water as the medium of heat transfer. The proper operation of the hydronic system depends upon the proper distribution (balance) of this water to all parts of the system under design load, as well as all part load conditions.

Automatic balancing has numerous advantages over manual balancing, especially in variable speed pumping systems (See Page 3).

Fewer Valves Required

Systems utilizing automatic flow control valves require far fewer balancing valves than systems that are manually balanced. Figure 1 shows a schematic of a system serving 18 heat transfer (heating or cooling) coils.

The manual system, shown on the left, requires a total of 27 valves whereas the automatic system, on the right, requires only 18 because it does not require the “partner balancing valves” (shown in red) on the risers and the branches.

As each terminal unit automatic flow control valve is self-balancing over a wide differential pressure control range, the flow through the risers and the branches is also automatically controlled (balanced) without the use of additional valves.

Figure 1  Comparison of the Number of Valves Required In Automatic vs. Manual Balancing
The elimination of the manual partner balancing valves on the mains, risers and branches in turn eliminates the head loss through them. Hence, the system head loss is reduced which lowers the pump brake horsepower (BHP).

2. Better Flow Balance Accuracy Under All Load and Flow Conditions

Properly designed and manufactured automatic flow control valves will control flow to within plus/minus 5% of design. All Griswold valves come with this guarantee.

Unlike manual balancing valves:

a. Automatic flow control valves have a spring loaded cartridge that dynamically absorbs pressure fluctuations resulting from changing flow conditions due to varying heating/cooling loads.

b. A change in differential pressure (\(\Delta P\)) across the automatic flow control valve does not change the flow through it.

c. Flow through any given automatic flow control valve will not change when the flow through an adjacent valve is increased or decreased.

In a manually balanced system, the flow accuracy is dependent not only on the quality of the valves but also on the expertise of, and the effort dispensed by, the person conducting the balancing procedure. Even then, flow balance is conducted at design load only and the manual balance valves are set accordingly. After the initial balancing effort, the flow through any given manual balance valve in the system will still vary as the \(\Delta P\) across that valve changes with system conditions. On an average, do not expect manually balanced systems to be more accurate than plus/minus 15%.

For a typical 100 ton chilled water system with automatic balancing, the flow will be within plus/minus 12 gpm as compared to plus/minus 36 gpm for a manual system. If the flow is much lower than design, one or more coils may not get enough chilled water. If the flow is much greater than design, you pay the penalty in higher utility bills due to higher pump BHP.

3. No Plumbing Restrictions

An automatic flow control valve can be plumbed anywhere in the line. Proximity to pipe bends, fittings, etc., upstream or downstream location, horizontal or vertical orientation, do not affect its performance.

To retain the calibrated accuracy of manual balance valves, there must be a minimum length of unrestricted straight pipe, upstream and downstream. The actual recommended minimum length varies by manufacturer. 3 to 10 pipe diameters upstream and 1 to 2 pipe diameters downstream are typical, except for Griswold’s 2.5” to 18” QuickSet valves with straightening vanes.

4. No Labor For Balancing, Minimal Labor for Verification

The procedure to manually balance a system is very labor intensive. Each time a valve is adjusted, the flow through the other valves will change including those that were previously set. Hence, the previously set valves must be reset, which in turn affects the flow through the other valves...and so on. In a large system, a minimum of 3 resets per valve is generally required. Also, the actual labor that will be required is difficult to estimate.

On the other hand, each automatic flow control valve is self balancing as soon as the pump is turned on. Therefore, the entire hydronic system with many such valves self balances. The only labor required is for flow verification. The pressure drop across each valve is measured by using the ports provided on the valve body. As long as the \(\Delta P\) is within the control range listed on the valve tag, the flow, which is also listed on the tag, will be within plus/minus 5%.

The total labor required for flow verification of an automatic system should be no more than 15% to 25% of that required to balance a manual system.

5. Building Renovation Does Not Require Hydronic System Rebalance

Very often, space renovation in an existing building also changes the heating/cooling requirements of that space. For example, an open office area that is converted into a large conference room will require more cooling due to
the additional sensible and latent heat from the people. This may result in an additional fan-coil unit for the conference room. Figure 2 illustrates this scenario for a Manual vs. Automatic system.

If this is a manually balanced building, as shown in Figure 2 on the left side, valve MBV #5 would have to be added and manually set. However, doing this would change the flows through existing valves MBV #1 through MBV #4 and they would also have to be reset. Similarly, upstream branch/riser balancing valves (not shown) may also have to be reset. The resulting labor cost can be significant.

If this is a building with automatic flow control valves, as shown in Figure 2 on the right side, you would only have to add valve AFCV #4. Because these valves have wide control ranges, they would all automatically self balance to provide the required flows. No labor would be required to set the new valve or to reset any of the existing valves.

### 6. No Coil Will Starve When Saving Money by Variable Speed Pumping

Chilled water systems with variable speed pumping save a lot of energy. As the building cooling load decreases, you can reduce the total amount of chilled water being circulated by slowing down the pump. Since the pump power is proportional to the cube of the speed, reducing the speed by only 33% (which is very common), reduces the power by about 70%!

However, reducing the total chilled water flow does not mean that all the coils in the building individually need the same reduction in flow. For example, on a typical spring day at 1:00 p.m., the total chilled water requirements of an 8-story office building will generally be much less than on a hot summer (design) day. However, the air-handler serving the filled-to-capacity cafeteria, on the first floor, will require almost 100% (of design) chilled water. A building with automatic flow control valves will give you this diversity whereas one with manual balancing valves cannot. Let’s take a look at the three hydronic system schematics in Figure 3 to understand why.

The schematic at the top shows the design load condition. The system operation point, at design load, is at (say) 125 feet of pump head. The head loss across the various elements (which adds up to 125 feet) for the cafeteria circuit, is as shown. Since the cafeteria is on the first floor, the head loss through the risers is negligible and is ignored. Please note, for design flow at design head, the head loss through the manual balancing valve is the same as that through an automatic flow control valve (86 feet).
The schematic in the middle shows what happens when system flow is reduced (by lowering the pump speed to 67%), if the system is manually balanced. At the lower speed, the pump head will be smaller. Let’s assume it’s decreased to 65 feet. Since nothing else has changed in the cafeteria coil circuit, the head loss through the various elements will decrease proportionately and now add up to 65 feet instead of 125. Since the head loss through the manual flow control valve is reduced to 44.7 feet and since flow is proportional to the square root of the head loss, the flow through the manual balancing valve (and the coil) is reduced to 72% (square root of 44.7/86). There is a flow deficit of 28%.

The schematic at the bottom shows what happens when system flow is reduced by the same amount (pump speed again lowered to 67%), if the system has automatic flow control valves. Again, the pump head decreases to 65 feet. However, the head loss distribution is not proportional. Instead, the cartridge inside the automatic flow control valve moves by a precise amount, to absorb only 26 feet of head and keeps the flow at the required 100%.

With the automatic flow control valve, there is no flow deficit at reduced system flow and reduced pump head.

(Note: In all three schematics of Figure 3, all losses in the pump room are ignored for clarity of discussion.)
Automatic Flow Control Cartridges

At the heart of every automatic flow control valve is the cartridge whose design, materials and manufacturing tolerances critically affect valve performance.

Three Types of Cartridges

Some companies offer you only one type of cartridge, in various sizes, for all their valves because all their valves are non-adjustable, single-flow. If you want to change the flow, you have to replace the cartridge. Griswold offers you single and multi-flow valves. We have a total of three types of adjustable and non-adjustable cartridges, allowing you tremendous flexibility in applications. The description of each cartridge follows. Also, on Page 8 of this guide, there is a quick reference table for all Griswold cartridges.

1. Standard Flow Cartridge

This is our most popular cartridge. It is a single flow, 100% stainless steel cartridge. Its construction is shown in the cutaway below, as Figure 4.

It consists of a hollow piston (also referred to as the cup) inside a housing. The piston has several ports (orifices) of various shapes and sizes that are designed by computer and cut very precisely. It has a unique noise-reduction feature; the ports are divided into segments to eliminate the gushing noise of water flowing through a single large port.

The piston moves inside a housing against a spring and is the only moving part. For every flow rate, there is a unique combination of port shapes and sizes.

The operation of the cartridge is illustrated in Figure 5.

The function of the cartridge is to keep flow constant, while absorbing the dynamic pressure fluctuations in the system, within its pressure differential control range.

This control range is shown in green in Figure 5. If the upstream pressure increases or downstream pressure decreases, the cup moves further into the housing to decrease the total orifice area by a predetermined, precise amount. If the upstream pressure decreases or downstream pressure increases, the cup moves further out of the housing, increasing the total orifice area again by a predetermined, precise amount.

Mathematically, in the flow equation,

\[ Q = Cv \sqrt{\Delta P} \]

where 
- \( Q = \) Flow (GPM)
- \( Cv = \) Cartridge flow coefficient (dependent on orifice area)
- \( \Delta P = \) Differential Pressure (PSID) across the cartridge.

Since the control ranges are quite wide, you don’t have to be very accurate in calculating the pressure drop; just verify that the differential pressure will stay within the control range you select.

When the differential pressure across the cartridge...
falls below its control range (pink colored area in Figure 5), the cup will come all the way out, exposing the maximum orifice area. Similarly, if the differential pressure across the cartridge rises above its control range (blue colored area in Figure 5), the cup will move all the way in, exposing the minimum orifice area. In both cases, the cartridge will now act as a fixed orifice device, varying flow based on the out-of-range differential pressure.

You do not have to worry about the cartridge ever shutting off the flow completely because a minimum orifice area is always open.

Figure 6 shows the Knifing Action inherent in the design of the Griswold Standard Flow Cartridge. The stainless steel cup is pressed in and out as flow changes. The hardness of the material crushes or cuts through any trapped debris which may have become lodged in the flow orifices, clearing the system. When the valve is isolated periodically, the cartridge will spring all the way open, exposing all the large flow orifices, and allowing all particles to pass through.

**THE GRISWOLD DIFFERENCE IN STANDARD FLOW CARTRIDGES**

Since 1960, all our standard flow cartridges have been 100% stainless steel. We have seen other flow control companies resort to plating a cheaper, softer metal such as brass, with a very thin layer of hard metal such as nickel. We choose not to coat because it is very difficult to apply a uniform thin coat of metal over the complex shape of a ported piston. If any spot is missed, the exposed soft metal will further erode over time, due to the constant flow of water. Secondly, the slightest misalignment of the cup and housing will scrape away the coating due to the rubbing motion of the cup inside the housing. Again, the exposed soft metal will further erode. Both instances will deteriorate the desired smooth flow characteristics of the cartridge and lower its accuracy.

To validate the performance of our cartridges over time, we flow tested several that had been in service for 22 years at a major U.S. airport. Our tests showed that all cartridges still controlled flow within the guaranteed plus/minus 5%. This was all the more remarkable because they were controlling the flow of condenser water, which is much more punishing on the cartridge since it is much dirtier than chilled water.
2. The Hi-Flow Cartridge

Today, engineers want more than a properly functioning hydronic system. They are demanding two additional things: more flow and a lower pressure drop (head loss) through the automatic flow control valve.

The higher flow allows them to select a smaller size valve (resulting in a lower initial cost) and the lower pressure drop reduces the pump BHP.

To fill this need, Griswold offers a Hi-Flow, all stainless steel cartridge as shown in Figure 7. It is used in multiples, in wafer valves, as shown in Figure 8.

Figure 9 shows a Griswold Wafer valve specification sheet. If the building design requires a wafer valve that controls flow at 2000 GPM and you select one with Standard Flow Cartridges, the valve size would be 12" (see selection marked with red ovals in Figure 8) with a head loss of 30 feet and a nominal control range of 8 to 128 PSID. Instead, if you select one with Hi-Flow cartridges, the valve size would be 10" (see selection marked with blue ovals in Figure 9) with a head loss of only 11.5 feet and a nominal control range of 5 to 32 PSID.

Would you ever select the larger size (12") valve? Yes, if you had a retrofit situation where you could not replace/modify the existing pump which was so oversized that your valve had to absorb more than 32 PSI, the maximum pressure difference for the High-Flow cartridge. In this case, the proper selection would be the 12" valve with the nominal control range of 8 to 128 PSID.

The Hi-Flow cartridge design also allows suspended particles, in dirty water, to pass through very easily. Hence, it is ideal for controlling condenser water flow.
3. Externally Adjustable Cartridge

The externally adjustable cartridge is the easiest to adjust of all our cartridges. Here, you don’t have to remove the cartridge to adjust the flow. The desired maximum flow rate can be easily changed while the system is in operation. Figure 10 shows a valve with an externally adjustable cartridge.

To change the flow, the key on top is rotated until the 2-digit numeric display corresponds to the desired flow. The numeric display (setting) vs. flow rate chart is provided by Griswold. The key is removable after setting the flow to make the valve setting tamper proof.

Like the other Griswold flow cartridges, the externally adjustable cartridge features plus/minus 5% accuracy. Like the other cartridges, a

### Table 1 Quick Reference Table – 3 Types Of Cartridges

<table>
<thead>
<tr>
<th>Griswold Cartridge Selection</th>
<th>Standard Flow</th>
<th>Hi-Flow</th>
<th>Externally Adjustable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valve Sizes</td>
<td>1/2&quot; to 30&quot;</td>
<td>4&quot; to 30&quot;</td>
<td>1/2&quot; to 1-1/2&quot;</td>
</tr>
<tr>
<td>Flows (GPM)</td>
<td>0.33 to 12,750</td>
<td>100 to 17,000</td>
<td>0.7 to 30.9</td>
</tr>
<tr>
<td>Nominal Control Ranges (PSID)</td>
<td>1 to 14</td>
<td>3 to 18</td>
<td>4.93 to 43.1</td>
</tr>
<tr>
<td></td>
<td>2 to 32</td>
<td>5 to 32</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 to 57</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8 to 128</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
valve featuring the externally adjustable cartridge will automatically re-adjust to maintain the selected flow rate. This eliminates the need to exactly know the distribution of pressure within a system.

Because of this dynamic reaction feature, one or more of the valves in the system can be re-adjusted without upsetting other circuits.

4. Smooth Flow Curves Without Bumps, Dips and Gaps

All Griswold cartridges are designed and manufactured to give a continuous and smooth flow curve across their entire nominal flow control range in hot and chilled water systems, as shown in Figure 11.

We have also studied the published flow rate calibration tests of other cartridges on the market and have found many unacceptable because their flow curves have bumps, dips and gaps, as shown in Figures 12 and 13. Some other manufacturers’ cartridges also flow out of their published range when subjected to temperature changes within the system.

The bump represents a sudden increase in flow for a small change in the differential pressure and the dip represents sudden decrease. The large amounts of energy released by these sudden surges, for flows above 50 gpm, can cause pipe anchors to come off the wall! In our experiments, we’ve seen anchored test stands lift right off the concrete floor. Such surges, even within the plus/minus 5% flow accuracy, are highly unacceptable.

The gap represents loss of flow control across the corresponding pressure differential range. The valve’s performance will keep jumping from one side of the gap to the other, causing pipe noise and severe vibrations.

It is very important that the cartridge flow curve be smooth without bumps, dips or gaps.

Figure 11  The Griswold Flow Curve

Figure 12  Unacceptable Flow Curve – Bumps and Dips

Figure 13  Unacceptable Flow Curve – Gaps
For open and closed systems, automatic flow control valves have generally been installed on the return side of the coil. In fact, the return side location had become a rule of thumb until recently. The rule makes a lot of sense in certain open systems. In Figure 14, if the valve is on the supply side, the top of the coil may not remain fully flooded, especially in low flow situations. This will impede heat transfer since air is a good insulator.

In 1974, Griswold first experimented with automatic flow control valves on the supply side of the coil in HVAC chilled and hot water applications.

We found the valves performed exactly the same as on the return side and there was no negative impact on system performance.

Specifically, there were no problems of cavitation, air entrainment or noise that some engineers are concerned about. This was no surprise since no component is ever without water in pumped closed systems and the performance of automatic flow control valves is location independent. Figure 15 further illustrates this point.
Griswold has taken the combination valve to a whole new level with its all-in-one Automizer valve. This unique valve combines an actuated temperature control with our 100% stainless steel flow limiting cartridge. Other benefits include a Universal Mounting Plate to fit many different actuators, Griswold’s patented Flow Optimizer (Figure 17), an isolation ball valve to isolate the coil and a standard air vent. The Automizer was designed to function with low-torque 35 inch-pound actuators, which saves you money and energy.

Flow limit and actuated ball valve temperature controls can be integrated into the same valve body because they perform sequentially. Temperature controls are selected by Cv to achieve a specific upward limit for GPM flow. While actuated ball valves now provide more Cv selection than traditional globe valves, there can still be overflow conditions at a specific coil location.

This is when the automatic flow limit control does its job. It only limits flow to the specific GPM selected for a specific coil and thereby permits the unwanted water to be diverted (to less resistant circuits) and flow through the system to meet demand from other locations. The temperature control has complete authority throughout its design flow; the automatic flow control has authority only when the temperature control is fully open and flow would normally exceed the specific GPM selected by the design engineer.

**Figure 16** Griswold’s Versatile Combination Actuated Temperature Control Valve, The AUTOMIZER

**Figure 17** The Patented Flow Optimizer

*Griswold’s Flow Optimizer (US Patent #5,937,890) ensures Equal Percentage Flow while lowering Cv’s to levels previously available only in more expensive globe valves*
Griswold Coil Piping Packages consist of pre-plumbed components on a hard pipe or flexible hose that connect to the heating or cooling coil on one side and to the stubbed out supply and return lines on the other.

The components include manual balancing valves, automatic flow control valves, ball valves, Y-strainers, two and three way automatic temperature control valves like Griswold’s Unimizer, drain valves, unions, hose bib adapters, air vents, pressure/temperature test valves, etc. Special features of Coil Piping Packages allow them to occupy a much smaller footprint than a functionally equivalent field-plumbed assembly.

Engineers do not have to design or detail the various elements that are required at the supply and return end of each coil. They need only select a package from the Griswold Standard Coil Piping Package Catalog. Variations to standard packages are welcomed and readily accommodated.

Owners save money because they do not have to pay for costly field labor to assemble the components or for checking whether every component is plumbed in the correct order, per design. Additional savings result by choosing Griswold components which integrate many components into single multi-function valves.

- Supply side isolation ball valve, Y-strainer and automatic flow control valve, as 3 separate components, cost more.
- Requires more time to plumb the 3 separate components. Higher labor cost.
- Greater potential for future leaks due to many pipe connections.
- 3 components require more space for installation.

**Typical Coil Return Side Flow Control**

- The Isolator R and Isolator S package incorporates multiple components in one valve body, costs less and guarantees that a strainer is installed as specified.
- Requires less time to plumb, fewer components and threaded connections. Labor savings.
- Future leak potential minimized due to fewer pipe connections.
- The compact IRIS Package can be installed in tight spaces.

**Multi-Function IR-IS Package**

**Figure 18** The Benefits of Multi-Function Coil Piping Packages
There are four different styles of Coil Piping Package available from Griswold Controls.

1. Simple, non-actuated packages

2. Packages with a Griswold 2-Way Unimizer Actuated Temperature Control Valve or a third party ATC, installed at Griswold.

3. Packages with a Griswold 3-Way Unimizer Actuated Temperature Control Valve or a third party ATC, installed at Griswold.

4. The Griswold AUTOMIZER 2-Way Package, which incorporates the Flow Control and the Temperature Control into the same valve.

The figures below show some representative Coil Piping Packages. For complete model number information, please refer to the Griswold Controls Coil Piping Package Catalog, form number F-4311A.

Engineers who use Griswold Coil Piping Packages have reported significant time savings in the design process. Contractors who use Coil Piping Packages report labor savings of approximately 2–3 times their standard labor costs to purchase and package similar units in the field.

Each package is assembled according to customer specifications by the highly skilled team at our factory in Irvine, California. The parts are placed in their exact required configuration, labelled or tagged, wrapped for added protection, and shipped to the jobsite, ready for installation.

Figures 19 through 23 represent just a few of the many packages available from Griswold Controls.
**Figure 21** CPP2IRISU Automatic Package

**COMPONENTS in direction of flow**

**Return Side:** Union with Manual Air Vent, Unimizer Actuated Ball Valve Temperature Control, Isolator™ R including Stainless Steel Flow Cartridge, Integrated Isolation Ball Valve and Two P/T Test Valves

**Supply Side:** Isolator™ S Including Isolation Ball Valve, Strainer, Drain Valve and P/T Test Valve

*Available 1/2” – 2”*

**Figure 22** CPP2A All-In-One Automizer Package

**COMPONENTS in direction of flow**

**Return Side:** AUTOMIZER Combination Valve with Automatic Flow Limiting Cartridge, Isolation Ball Valve, Actuated Ball Valve Temperature Control, Manual Air Vent and Two P/T Test Valves

**Supply Side:** Isolator™ S Combination Valve Including Isolation Ball Valve, 20 Mesh Stainless Steel Strainer, P/T Test Valve and Drain Valve

*Available 1/2” – 1-1/2”*

**Figure 23** CPP3IRISU 3-Way Automatic Package

**COMPONENTS in direction of flow**

**Return Side:** Union with Manual Air Vent, Unimizer 3-Way Actuated Ball Valve Temperature Control, Isolator™ R Combination Valve including Automatic Flow Cartridge, Integrated Isolation Ball Valve and Two PT Test Valves

**Supply Side:** Isolator™ S Combination Valve Including Isolation Ball Valve, 1/2” Bypass Port, 20 Mesh Stainless Steel Strainer, Drain Valve and P/T Test Valve

*Available 1/2” – 2”*
Selection Procedure

Given below is a step-by-step selection procedure for two automatic flow control valves and one coil piping package in a sample project.

Sample Project

A college campus will add a new building. The chilled and condenser water line is shown in Figure 24 below. The chilled water lines are shown in blue and the condenser water lines are shown in green.

The new building will require a 350 ton water chiller with 1050 GPM condenser water. There are two existing cooling towers which supply condenser water to several other chillers on campus. The cooling towers have adequate excess capacity for the new chiller. The college wants the flexibility to switch between cooling towers.

a. Select a wafer valve (AFCV#1 in Figure 24) to control condenser water flow at 1050 GPM at all times.

b. The 3rd floor will have a computer lab whose equipment has not been selected. The design cooling load for the fan coil unit (coil #31) will end up between 5 tons (12 GPM) and 8 tons (19.2 GPM). Select an externally adjustable automatic flow control valve (AFCV #2 in Figure 24).

c. The fan coil unit #42 on the 4th floor has a design load of 2 tons (4.8 GPM) and is controlled by a 2-way automatic temperature control valve. Select a hard-piped (as opposed to flexible hose) coil piping package (CPP #1 in Figure 24) from the Griswold Coil Piping Package Catalog.

Step 1. Go to the pump schedule on the design drawing (or the pump curve) and for the condenser water pump note the head corresponding to the desired flow of 1050 GPM. Let’s say it is 140 feet.
Let’s say it is 95 feet.

**Step 3.** Calculate the approximate head loss through the open circuit ABCDEFG (in Figure 24) for cooling tower #2 without the automatic flow control valve. Let’s say it is 125 feet.

**Step 4.** The difference between the pump head and the system head loss has to be absorbed by AFCV #1 under all conditions. Calculate this difference. From Steps 1, 2 & 3, the difference is 45 feet (140 - 95) or 19.5 PSI when cooling tower #1 is supplying condenser water. The difference is 15 feet (140 - 125) or 6.5 PSI when cooling tower #2 is supplying condenser water.

**Step 5.** From the design drawing, note the condenser water pipe size (BC in Figure 24) to the chiller. Let’s say it’s an 8" pipe.

**Step 6.** In the Griswold Catalog, go to the back side of the wafer valve (Class 150) specification sheet F-3023 (reproduced as Figure 25).

**Step 7.** In the first column of both tables in Figure 25, find your pipe size (8") and look across that row for the maximum GPM greater than or equal to the required 1050. Note that two values (1050 & 1400) meet this criteria.

**Step 8.** Go to the 4th row (head loss in feet) and note, for the two columns that contain the choices in step 7, the head losses are 30.0 feet and 11.5 feet.
feet respectively. The head loss represents the minimum required pressure drop across the valve before it can start controlling flow to plus/minus 5% of design. Since 30 feet is greater than the minimum value (15 feet) in step 4, you discard that choice.

**Step 9.** Your remaining choice has the nominal control range of 5 to 32 PSID (row 2), which can absorb a maximum pressure difference of 32 PSI (row 3). Since 32 PSI is greater than both differences (19.5 PSI & 16.5 PSI) calculated in Step 4, this valve is the correct choice. Note it has a Hi-Flow cartridge (row 1).

**Step 10.** The first digits of the model # for this valve are 337 (column 2). The last digit is 5, which is the low end of the nominal control range (5 to 32) from step 9. Specify valve model #3375 @ 1050 GPM.

### Selection (b) For Externally Adjustable Valve

**Step 1.** Go to the pump schedule on the design drawing (or the pump curve) and for the chilled water pump note the head at design flow. Let’s say it is 200 feet at 840 GPM.

**Step 2.** Calculate the approximate head loss for the chilled water closed circuit (JKLMNPQRSJ in Figure 24) through coil #31 without the automatic flow control valve (AFCV #2). Let’s say it is 150 feet.

**Step 3.** Calculate the difference between the pump head and the circuit head loss. From Steps 1&2, the difference is 50 (200-150) feet or 21.6 PSI.

**Step 4.** From the design drawing, note the size of the supply and return lines (LM & NP). Let’s say that the size is 1-1/2” (both lines should be the same size).

**Step 5.** In the Griswold Catalog, go to the externally adjustable valve (SH) specification sheet #F-2994 (reproduced as Figure 26).

**Step 6.** Go to the third row of numbers and note that for a 1-1/2” valve, the model # is 3F200 and the PSID (control) range is 4.93 to 43.1.

**Step 7.** Verify whether the valve PSID range is adequate. Since the valve must absorb 21.6 PSI (Step 3), which is within the PSID range (4.93 to 43.1) form Step 6, it is adequate.

**Step 8.** Specify valve model # 3F200.

**Step 9.** Let’s say, after the contractor receives the valve the computer lab equipment is finalized. This results in a design cooling load which requires 17 GPM chilled water. The contractor goes to the chart on F-2994 (which is also included with the valve) and notes that the dial setting as 2.6 (column 4) for 17 GPM flow control by model 3F200 (column 6). The contractor adjusts the setting on the valve to 2.6, using the key that comes with the valve. The valve will now control flow to within plus/minus 5% of 17 GPM while dynamically absorbing pressures of 4.93 to 43.1 PSI (if the system pressure fluctuates that much)!
Step 1. Same as Step 1 of Selection (b), i.e. you note that the chilled water pump will provide 840 GPM with 200 feet of head.  

**SPECIFICATIONS**

- **PSI/Temperature Rating:** 400 PSI/250°F  
- **Cartridge:** AISI Type 304 Stainless Steel  
  AISI Type 17-7 PH Stainless Steel Spring  
- **Strainer:** 20-Mesh Stainless Steel  
- **Body Material:** Forged Brass  
- **End Connections:** Brass  
- **Seals:** EPDM O-Rings  
- **Body Tappings:** Port 1 and 2: 1/4” NPT with P/T test valves  
  Port 4, Drain: 1/4” NPT in IY1, 1/2” NPT in IY2  
- **Ball Valve:** Nickel-Plated Brass Ball  
- **Assembly:** Valve comes fully assembled  

**ACCESSORY OPTIONS:**

- **Body Tappings:**  
  - Port 2: 1/2” NPT (Optional)  
  - Port 3: 1/4” NPT (Optional)  

**FLOW RATES (±5%)**

<table>
<thead>
<tr>
<th>SIZE</th>
<th>MODEL NO.</th>
<th>HEAD LOSS IN FEET</th>
<th>PSID RANGE</th>
<th>GPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2”,</td>
<td>IY11</td>
<td>3.5</td>
<td>1–14</td>
<td>0.33, 0.50, 0.67, 1.00, 1.33, 1.67, 2.00, 2.33, 2.67, 3.33, 4.00, 4.67, 5.00</td>
</tr>
<tr>
<td>3/4”,</td>
<td>IY12</td>
<td>7.4</td>
<td>2–32</td>
<td>0.55, 0.76, 1.00, 1.50, 2.00, 2.50, 3.00, 3.50, 4.00, 5.00, 6.00, 7.00, 8.00</td>
</tr>
<tr>
<td>1”</td>
<td>IY14</td>
<td>13.4</td>
<td>4–57</td>
<td>0.75, 1.00, 1.33, 2.00, 2.67, 3.33, 4.00, 4.67, 5.33, 6.67, 8.00, 9.33, 10.00</td>
</tr>
<tr>
<td></td>
<td>IY18</td>
<td>30.0</td>
<td>8–128</td>
<td>1.10, 1.50, 2.00, 3.00, 4.00, 5.00, 6.00, 7.00, 8.00, 10.0, 12.0, 14.0, 16.0</td>
</tr>
</tbody>
</table>

Step 2. Calculate the approximate head loss for the chilled water closed circuit (JKLTUVWPQRSJ in Figure 24) through coil #42 without the automatic flow control valve (AFCV #3). Let’s say it is 182 feet.  

Step 3. Calculate the difference between the pump head and the circuit head loss. From Steps 1 & 2, the difference is 18 (200 - 182) feet or 7.8 PSI.  

Step 4. From the design drawing, note the size of the supply and return lines (TU & VW). Let’s say the size is 3/4” (both lines should be the same size).  

Step 5. In the Griswold Catalog, go to the Isolator Y specification sheet F-4203, reproduced as Figure 27.  

Step 6. In the “FLOW RATES” table, note that you can choose from three model #s (column 2) because:  

(i) All three give you flows that are very close to 4.8 gpm (column 5).  

(ii) All three have “head loss in feet” (column 3) less than 18 (from Step 3).  

(iii) The 7.8 PSI you calculated in Step
3 falls within each of the 3 PSID (control) ranges (column 4).

**Step 7.** Since 2 – 32 PSID is the most common control range used in HVAC and since it falls in the middle, you choose that range with 5 GPM flow (which is the closest to and slightly greater than 4.8 GPM). This gives you model IY12.

**Step 8.** In the Griswold Coil Piping Package Catalog, you look for a package with a hard-piped *Isolator Y* on the supply side and a 2-Way ATC (automatic temperature control) valve on the return side of the coil.

**Step 9.** You specify Coil Piping Package 2Y with model IY12 (from Step 7) *Isolator Y* valve.

You also specify the manufacturer, model #, size and Cv of the 2-Way ATC valve which will be shipped to Griswold to be factory assembled in your coil piping package. Or, you can select the Griswold Unimizer of your choice from form #F-4206 or The Griswold Actuated Control Valve Catalog (form # 4244)

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**Guide Specifications**

Given below are items to include in your specifications of automatic flow control (balancing) valves and coil piping packages. Their inclusion will ensure you’ll get quality flow control with important features for optimum dynamic hydronic balancing as well as factory assembled coil piping packages.

(Note: Individual product specification sheets give additional information)

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**Specifications**

1 AUTOMATIC FLOW CONTROL VALVES

1.1 PRODUCT WARRANTY AND PERFORMANCE GUARANTEE

1.1.1 Valves shall be warranted by the manufacturer to be free of defects in material and workmanship for a period of 5 years.

1.1.2 Valves shall control flow to within plus/minus 5 percent of design.

1.1.3 The valve flow curve shall be smooth over its entire nominal control range. Gaps, bumps and dips in flow curves shall not be acceptable.

1.1.4 For a nominal fee, manufacturer shall provide certified, independent laboratory tests verifying performance.

1.2 VALVES WITH SINGLE (NON-ADJUSTABLE) FLOW CONTROL CARTRIDGES

1.2.1 All non-adjustable flow control cartridges shall be 100% stainless steel. Parts made of soft metals such as brass with only a coating of hard metal such as nickel shall not be allowed. Rubber based materials whose properties change with temperature and pressure shall not be allowed.

1.2.2 The cartridges shall have many segmented ports through which water can pass, rather than a continuous large port, to eliminate noise.

1.2.3 The cartridge movement shall result in a shearing action that will dislodge or shear any particle that may tend to get stuck in a port.

1.3 VALVES WITH EXTERNALLY ADJUSTABLE CARTRIDGES

1.3.1 All externally adjustable cartridges shall include only non-abrasive and non-corrosive thermoplastic materials, whose shape and properties will not change over the life of the valve.

1.3.2 The valve flow rate shall be field adjustable from the outside by turning a key provided by the valve manufacturer. The cartridge shall not have to be removed from the valve body to adjust the flow rate.

1.3.3 The valve flow rate shall be easily determined by first reading a 2-digit numeric display next to the key hole, and then, reading the actual flow rate from a chart. The numeric display (setting) vs. flow rate chart shall be provided by the manufacturer.

1.3.4 Valves shall be available in end connection sizes of 1/2” – 1-1/2”

1.4 MULTI-FUNCTION VALVES

1.4.1 Multi-function valves that incorporate an isolation ball valve, a 20-mesh strainer and a flow control cartridge in the same body, may be substituted on the supply side of the coil for the same three items shown separately on the supply/return side of the coil. The valve manufacturer shall give the same five year warranty on these multi-function valves.

1.4.2 Multi-function valves such as the *Isolator™ Y*, indicated on the drawings, shall not be replaced by functionally equivalent separate components that increase the material and labor cost of the project.
1.5 WAFER VALVES

1.5.1 Wafer valves shall be available for pipe sizes ranging from 3” to 30” in diameter.

1.5.2 Wafer valves shall have a choice of cartridges in six different control ranges. They shall be available to control flow with pressure differentials as low as 1.3 PSI and as high as 128 PSI.

1.6 COIL PIPING PACKAGES

1.6.1 Factory assembled coil piping packages may be installed in lieu of separate field plumbed components indicated on drawings.

1.7 NO ADVERSE EFFECT ON SYSTEM PERFORMANCE

1.7.1 None of the valves, whether single or multi-function, and whether installed on the supply or return side of the coil, shall be the cause of noise, cavitation or air bubbles in the entire hydronic system.

1.8 MANUFACTURER

1.8.1 The manufacturer of all automatic flow control (balancing) valves and coil piping packages shall be Griswold Controls.

1.9 AUTOMIZER COMBINATION VALVE

1.9.1 Integral Control/Flow Rate Limiting Valve

1.9.1.1 Valve shall consist of a dynamic flow limiting device, an integral, electrically actuated two-way control valve, and manual isolation ball valve.

1.9.2 Actuated Ball Valve

1.9.2.1 Valve housing shall consist of forged brass, rated at no less than 360 PSI at 250°F.

1.9.2.2 Valve ball shall consist of chemically nickel plated brass.

1.9.2.3 Actuator stem shall be removable/replaceable without removing valve from line.

1.9.2.4 Manufacturer shall be able to provide ball insert to make flow control equal percentage.

1.9.2.5 Valve shall have EPDM O-rings behind ball seals to allow for a minimum close-off pressure of 100 PSI with 35 in-lbs of torque for 1/2” to 1-1/2” sizes.

1.9.2.6 Valve shall be available with over 30 unique Cv values.

1.9.2.7 Valve shall be available with fixed end female or fixed end sweat connections.

1.9.3 Flow Limiting Valve

1.9.3.1 Flow regulation cartridge assembly shall be precision ground, all AISI 300 Series stainless steel; shall be available in four PSID control ranges; minimum range shall be capable of being actuated by less than 1.5 PSID; and shall be capable of controlling flow to within plus/minus 5% of rated flow.

1.9.3.2 Flow regulation unit shall be readily accessible, for changeout or maintenance.

1.9.4 Valve Actuator

1.9.4.1 Control valve actuator shall be analog modulating (4–10mA or 2–10V), floating (tri-state), Pulse Width Modulation or two position, as indicated in control sequence.

1.9.4.2 Shall be powered by either 24 VAC, (50/60 Hz) or 24 VDC. Power consumption shall not exceed 12 watts at 24 VAC.

1.9.4.3 Actuator shall provide minimum torque required for full valve shutoff position.

1.9.4.4 A 3 foot cable shall be provided for installation to electrical junction box.

1.9.5 Accessories

1.9.5.1 Identification tags shall be available for all valves; tags shall be indelibly marked with Cv, model number, location: tags shall be 3” x 3” aluminum.

Conclusion

We at Griswold hope that this publication has furthered your understanding of automatic flow control and has introduced you to new products such as multi-function, externally adjustable and combination valves. We also hope that you will no longer be apprehensive in specifying supply side flow control products. Our repeat customers tell us they are a better value than the traditional return side flow control products. Please call upon us to meet all your automatic flow control needs, from the simplest to the most challenging. Our network of representatives, the Griswold field organization and the knowledgeable factory staff are eager to help you select any Griswold product.

...Our experience does work for you!
Manual Balance

Manual Balance Valves are a simple solution for a balanced system with constant speed pumping.

Automatic Flow Control

Griswold pioneered Automatic Flow Control with its Stainless Steel Flow Cartridge in 1960. These valves were formulated especially for variable speed pumping.

Actuated Control

The most versatile actuated ball valves in the industry, plus pressure-independent self-balancing valves designed for temperature control.

Separator Systems

Add the finishing touches to your piping system with a Centrifugal Separator System to ensure continuous media-free filtration.